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Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980

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Nutritional status is the best global indicator of well-being in children. Although many surveys of children have been conducted since the 1970s, lack of comparability between them has made it difficult to monitor trends in child malnutrition.

Cross-sectional data from 241 nationally representative surveys were analysed in a standard way to produce comparable results of low height-for-age (stunting). Multilevel modelling was applied to estimate regional and global trends from 1980 to 2005.

The prevalence of stunting has fallen in developing countries from 47% in 1980 to 33% in 2000 (i.e. by 40 million), although progress has been uneven according to regions. Stunting has increased in Eastern Africa, but decreased in South-eastern Asia, South-central Asia and South America; Northern Africa and the Caribbean show modest improvement; and Western Africa and Central America present very little progress.

Despite an overall decrease of stunting in developing countries, child malnutrition still remains a major public health problem in these countries. In some countries rates of stunting are rising, while in many others they remain disturbingly high. The data we have presented provide a baseline for assessing progress and help identify countries and regions in need of populationwide interventions. Approaches to lower child malnutrition should be based on successful nutrition programmes and policies.

Keywords: child; child malnutrition disorders, epidemiology; infant nutrition disorders, epidemiology; child development; growth disorders; body height; body weight; nutrition surveys.

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Voir page 1231 le résumé en français. En la página 1232 figura un resumen en español.

Introduction

The best global indicator of children's well-being is growth, because infections and unsatisfactory feeding practices, or more often a combination of the two, are major factors affecting their physical growth and mental development (*1*). Poor growth is attributable to a range of factors closely linked to overall standards of living and the ability of populations to meet their basic needs, such as access to food, housing and health care. The assessment of growth not only serves as a means of evaluating the health and nutritional status of children but also provides an excellent measurement of the inequalities in human development faced by populations.

Children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have increased numbers of severe diarrhoeal episodes and a heightened susceptibility to certain infectious diseases, e.g. malaria, meningitis and pneumonia (*2–4*). There is an association between increasing severity of anthropometric deficits and mortality, and a substantial contribution is made by all degrees of malnutrition to child mortality (*5–7*). Strong evidence exists that poor growth is associated with delayed mental development (*8*, *9*) and that there is a relationship between impaired growth status and both poor school performance and reduced intellectual achievement (*10*, *11*). Growth retardation in early childhood is also associated with significant functional impairment in adult life (*1*, *10*) and reduced work capacity (*12*), thus affecting economic productivity.

The lack of comparability between survey results has presented a major difficulty in monitoring trends in child malnutrition. Many nutritional surveys were conducted during the 1980s and 1990s but various anthropometric indicators, reporting systems, cut-off points and reference values were used, making comparison between the studies difficult. This prompted WHO in 1986 to begin the systematic collection and standardization of data on the nutritional status of children aged under 5 years. The initial results (*13*) were updated in 1997 and estimates of trends in child growth retardation in developing countries were derived (*14*). The present article provides further updating and describes trends in child malnutrition on the basis of the largest

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compilation ever assembled of nationally representative nutritional surveys.

Methods

Cross-sectional data on the prevalence of child malnutrition were obtained from nationally representative nutritional surveys included in the WHO Global Database on Child Growth and Malnutrition. This database was initiated in 1986 to compile, standardize and disseminate the results of nutritional surveys performed in both developing and developed countries (*14*). A distinct feature is the systematic analysis of raw data sets in a standard format so as to produce comparable results. The methodology used in the standard analysis of individual country surveys has been described elsewhere (*13*, *14*). Low height-for-age, low weight-for-height and low weight-for-age are the anthropometric indicators traditionally used to assess child nutritional status. The present analysis focuses on low height-for-age, i.e. stunting, because this indicator best reflects long-term cumulative effects resulting from inadequate diet and/or recurrent illness (*1*, *13*). The prevalence of low height-for-age is defined as the proportion of children that fall below –2 standard deviations (SD) of the United States National Center for Health Statistics/WHO international reference median value.

Only nationally representative data derived from surveys conducted in developing countries were used. The sampling methods for each survey were reviewed to ensure national representativeness.[a] The survey results were checked for inconsistencies between the estimates based on height-for-age, weight-for-age and weight-for-height. The observed SD value of the *Z*-score distribution was used for assessing the quality of the data in the survey results. With accurate age estimates and anthropometric measurements, the standard deviation of the observed height-for-age, weight-for-age and weight-for-height *Z*-score distribution should be relatively constant and close to the expected value of 1.0 for the reference distribution, ranging within approximately 0.2 units. This nearly constant SD in height-based and weight-based *Z*-score distributions provides an opportunity to assess data quality (*1*). Surveys with an SD outside the expected ranges required closer examination in order to determine whether there were problems related to age assessment and anthropometric measurements. Surveys with inaccurate data attributable to measurement error or incorrect age reporting were excluded from the analysis.

Multilevel modelling, a generalization of standard regression employing multiple levels or units, was used in the statistical analysis to estimate regional and global trends of stunting (*15*). The data set that we constructed had three levels: region, country and survey year. Each level was a potential source of variability in the prevalence of stunting. Multilevel modelling was implemented using *SAS proc mixed* (*16*), a procedure that accommodates both categorical and continuous covariates and incomplete series of time measurements and allows for the added variability introduced by multiple levels of analysis.

Ideally, the analytical approach would have been to fit curves relating the prevalence of stunting to the survey year for each country, using random coefficient modelling. This would have allowed each country to have its own intercept and regression coefficient (or coefficients) for the relationship. However, there were not enough countries with more than two survey years for this to be possible, and a simplified version of a random coefficient model with only random intercepts was therefore used. The countries each had their own intercepts but shared common regression coefficients for the relationship of prevalence of stunting to survey year (*15*). This simplified random intercept model gave the same estimates of the overall trends and prevalences as would have been provided by the more complex model.

The model accommodated the variable patterns of available surveys for the countries. Countries with one survey contributed information only to the estimation of the overall intercept, whereas those with more than one survey also contributed to the estimation of the regression coefficient (or coefficients) relating the trend to the survey year.

Countries were grouped according to the UN classification system (*17*), which closely follows their geographical distribution. Separate analyses were performed for each UN region and for those subregions with sufficient data. Regional and subregional estimates were desirable because of the expectation that the trend in the prevalence of stunting would differ substantially between and within regions. Furthermore, a separate analysis for each region or subregion required two rather than three levels to be modelled, reducing substantially the complexity of the model.

In order to estimate the trends in the prevalence of stunting the multilevel model was fitted for each region and each subregion included, using the country populations as sample weights so that the influence of a country in the analysis was proportional to its total population. The models specified a linear relationship between prevalence of stunting and survey year, on the assumption that the rate of change in prevalence was constant. To determine if any regional trends were speeding up or slowing down, possible non-linear relationships were examined by including quadratic and cubic polynomial terms. No evidence of non-linear relationships was found for any region or subregion. The fitted equations were used to estimate prevalences for the years 1980, 1985, 1990, 1995, 2000 and 2005. Given the assumption of straight-line projection, uncertainty in the trends was quantified using 95% confidence intervals. The *estimate* statement of the *SAS proc mixed* procedure was used to calculate the confidence intervals. The numbers of stunted children aged under 5 years were

[a] Country-specific details on sampling procedures can be obtained upon request from Dr de Onis.

Table 1. **Numbers of countries and data points for stunting, by UN regions and subregions, used in the study**

UN regions and subregions	Number of countries/total	Number of data points	Number of countries with at least two data points
Africa	44 / 53	97	32
Eastern Africa	16 / 17	12	
Middle Africa	5 / 9	8	3
Northern Africa	6 / 6	16	4
Southern Africa	4 / 5	8	2
Western Africa	13 / 16	31	11
Asia[a]	32 / 46	68	14
Eastern Asia[a]	3 / 4	3	0
South-central Asia	10 / 14	26	6
South-eastern Asia	7 / 10	18	4
Western Asia	12 / 18	21	4
Latin America and the Caribbean	24 / 33	68	18
Caribbean	6 / 13	15	4
Central America	7 / 8	17	6
South America	11 / 12	36	8
Oceania[b]	6 / 15	8	1
All developing countries	106 / 147	241	65

[a] Excluding Japan.

[b] Excluding Australia and New Zealand.

estimated using the latest revision of the *World population prospects* available at the time of analysis (*17*).

Results

Table 1 shows the numbers of countries and data points used in the analysis. Data were available for 241 nationally representative surveys from 106 countries, of which 65 had more than one data point (Fig. 1). In Africa, survey data were available for 44 of 53 countries, 32 having two or more data points. In Latin America and the Caribbean, 24 of 33 countries had at least one data point and 18 had two or more. In Asia, 32 of 46 countries had at least one data point and 14 had two or more. For the subregions, insufficient data were available to estimate trends for Middle and Southern Africa, Eastern and Western Asia, and Oceania.[b]

Fig. 2 and Table 2 show the estimated prevalence of stunted children from 1980 to 2005 by region and subregion, while Table 3 shows the corresponding numbers of stunted children. It is estimated that 32.5% of children aged under 5 years in developing countries will be stunted in 2000. There has been a steady improvement since 1980, when the estimated global prevalence was 47.1%, an overall decline of 0.73 percentage points per year having occurred over the last 20 years. It is estimated that by 2005 the prevalence for all developing countries will be about 29%. A steady decrease also occurred in Asia and in Latin America and the Caribbean, although their levels of stunting were very different. The prevalence in Asia decreased from 52.2% in 1980 to 34.4% in 2000, whereas in Latin America and the Caribbean it fell from 25.6% to 12.6% over the same period. The numbers of stunted children remain extremely high (Table 3). For 2000 it is estimated that there will be some 182 million stunted preschool children in developing countries, a decline of some 40 million since 1980; 70% live in Asia, mainly South-central Asia, about 26% live in Africa, and about 4% in Latin America and the Caribbean.

Africa

The pattern in Africa is quite distinct. The prevalence of stunting declined from 40.5% in 1980 to 35.2% in 2000, a decrease of only 0.26 percentage points per year. The highest level of stunting is found in Eastern Africa, where, on average, 48% of preschool children are currently affected. In this region, stunting has been increasing at 0.08 percentage points per year. This trend, together with high rates of population increase, translates into annual increases in the numbers of stunted children in Eastern Africa; over the period 1980–2000 the number of stunted preschool children increased from about 12.9 million to 22 million. This trend is expected to continue such that by 2005 there will be about 24.4 million. For Western Africa the estimated prevalence of stunting in 2000 is 34.9%, a proportion that has changed little in recent years, and the population is increasing; the

[b] Detailed information on each of the surveys included in the analysis can be obtained from the authors.

Fig. 1. **Coverage of national country survey data on trends of stunting among under-5-year-old children**

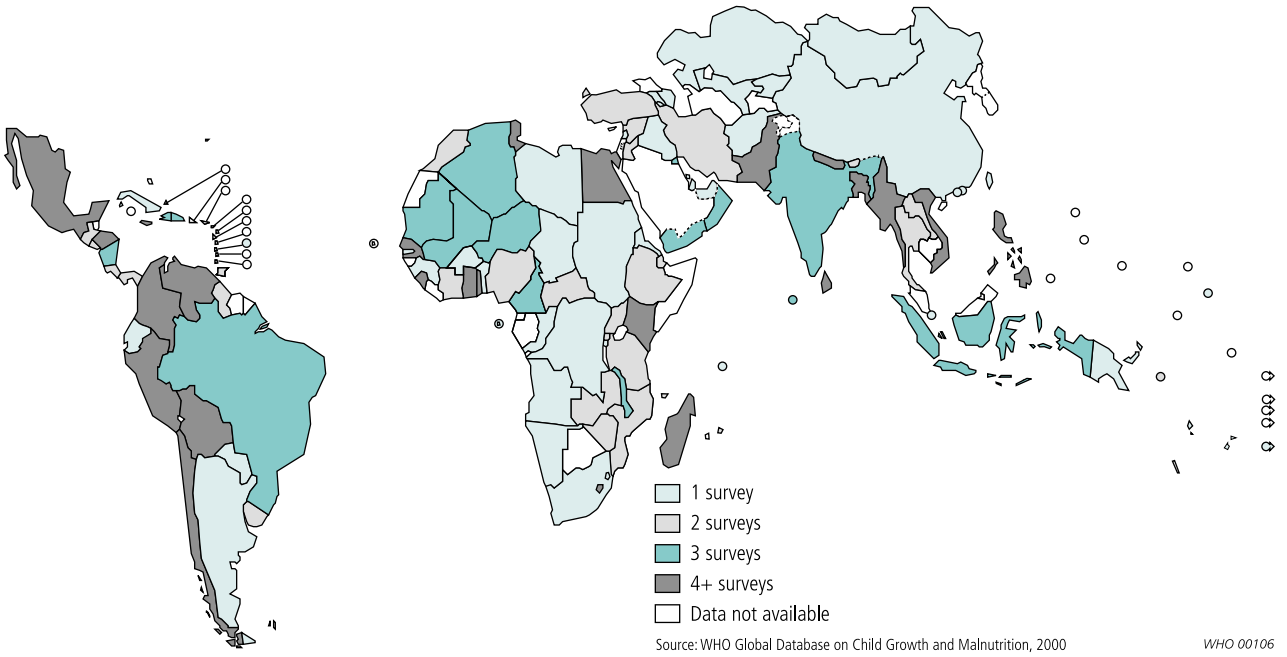
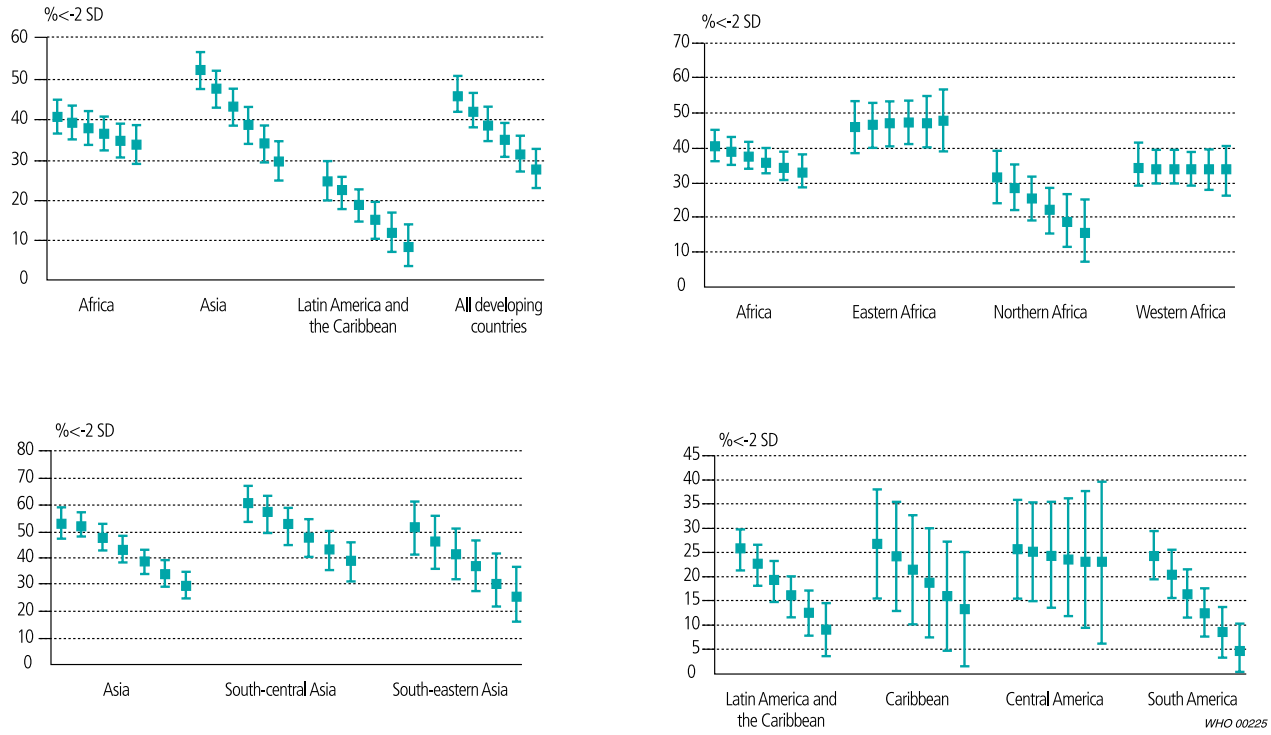


Fig. 2. **Trends in stunting (1980–2005) by UN regions with 95% confidence intervals** (box–whisker plots are at 5-year intervals)



number of stunted children is thus expected to increase by about 1.3 million between 2000 and 2005. In Northern Africa about 20% of preschool children, i.e. ca 4.4 million, are currently stunted. Between 1980 and 2000 the prevalence of stunted children in this subregion decreased from 32.7% to 20.2%. The decline that has occurred in both prevalence and numbers is expected to continue at a rate of 0.63 percentage points per year.

Asia

Stunting is widespread in South-central Asia but there is an improving trend. The estimated prevalence of stunting in 2000 is 43.7%, representing a substantial decrease of 0.86 percentage points per year from the prevalence of 60.8% for 1980. The number of stunted children has been decreasing over the past decade and it is expected that about 6.2 million fewer children will be stunted in 2005 than in 2000.

Table 2. **Prevalence of stunting in preschool children, by UN regions and subregions, over the period 1980 to 2005**

UN regions and subregions	Prevalence of stunting					
	1980	1985	1990	1995	2000	2005
Africa	40.5 (36.2–44.8)[a]	39.2 (35.4–43.0)	37.8 (34.2–41.4)	36.5 (32.8–40.2)	35.2 (31.1–39.3)	33.8 (29.1–38.5)
Eastern Africa	46.5 (39.0–53.9)	46.9 (40.4–53.4)	47.3 (41.2–53.4)	47.7 (41.3–54.1)	48.1 (40.7–55.4)	48.5 (39.8–57.2)
Northern Africa	32.7 (25.1–40.3)	29.6 (23.1–36.1)	26.5 (20.4–32.5)	23.3 (16.9–29.7)	20.2 (12.8–27.6)	17.0 (8.2–25.9)
Western Africa	36.2 (29.9–42.4)	35.8 (30.9–40.8)	35.5 (31.2–39.9)	35.2 30.6–39.8)	34.9 (29.2–40.6)	34.6 (27.4–41.7)
Asia	52.2 (47.6–56.8)	47.7 (43.3–52.2)	43.3 (38.8–47.7)	38.8 (34.4–43.3)	34.4 (29.8–39.0)	29.9 (25.2–34.7)
South-central Asia	60.8 (54.0–67.6)	56.5 (49.8–63.3)	52.2 (45.5–59.0)	48.0 (41.1–54.8)	43.7 (36.7–50.6)	39.4 (32.3–46.5)
South-eastern Asia	52.4 (42.6–62.2)	47.5 (38.0–57.1)	42.6 (33.2–52.1)	37.7 (28.2–47.2)	32.8 (23.1–42.6)	27.9 (17.8–38.0)
Latin America and the Caribbean	25.6 (21.4–29.7)	22.3 (18.4–26.3)	19.1 (15.1–23.1)	15.8 (11.6–20.1)	12.6 (7.9–17.3)	9.3 (4.1–14.6)
Caribbean	27.1 (15.8–38.3)	24.4 (13.3–35.5)	21.7 (10.6–32.8)	19.0 (7.8–30.2)	16.3 (5.0–27.7)	13.7 (2.0–25.4)
Central America	26.1 (15.9–36.2)	25.6 (15.7–35.4)	25.0 (14.5–35.5)	24.5 (12.5–36.5)	24.0 (9.9–38.0)	23.5 (7.0–39.9)
South America	25.1 (20.3–29.9)	21.1 (16.5–25.7)	17.2 (12.6–21.8)	13.2 (8.4–18.0)	9.3 (4.1–14.4)	5.3 (0.0–11.0)
All developing countries	47.1 (42.7–51.6)	43.4 (39.1–47.7)	39.8 (35.6–44.1)	36.0 (31.7–40.3)	32.5 (28.0–37.0)	29.0 (24.2–33.7)

[a] Figures in parentheses are 95% confidence intervals.

In South-eastern Asia it is estimated that 32.8% of preschool children will be stunted in 2000. This subregion has experienced an improvement rate of 0.98 percentage points per year, yielding a reduction of almost 20% between 1980 and 2000 (from 52.4% to 32.8%). This steady decrease is expected to continue such that by 2005 there will be over 3 million fewer stunted children. However, it is estimated that ca 19 million children in the subregion will be stunted in 2000.

Latin America and the Caribbean

The estimated prevalence of stunting in Latin America and the Caribbean has declined from 25.6% in 1980 to 12.6% in 2000. It is predicted that this trend will continue and that the prevalence will be 9.3% in 2005, given an average decline of 0.65 per-centage points per year. The three subregions had prevalences in the range 25–27% in 1980. However, the rates of improvement have varied considerably: 0.54%, 0.10% and 0.79% per year for the Caribbean, Central America and South America, respectively. The number of stunted children in Central America has changed little over the last 20 years, whereas in South America there has been a decrease from 8.4 million to 3.2 million over the same period.

Table 4 presents trends in stunting for those countries with data for more than one survey, including some very recent surveys not available when the multilevel modelling was completed. The percentage change per year was calculated by dividing the difference between the earliest and latest data points by the number of years between the survey points. Trends were classified as rising if the change per year was $\geqslant +0.3\%$, as falling if it was $\leqslant -0.3\%$, and as static if it was between these values. Trends of stunting were available for 70 countries, 31 of them in Africa, 19 in Asia, 19 in Latin America and the Caribbean, and 1 in Oceania. Of the African countries, 9 showed no obvious change between the earliest and latest data points, 9 showed a rising trend and 13 showed a falling trend. In Asia, 15 countries showed a decrease and 3 showed no change, only the Maldives showing a rising prevalence. In Latin America and the Caribbean, 14 countries presented a decreasing trend, 4 (Costa Rica, Honduras, Jamaica, and Nicaragua) a static trend, and 1 (Venezuela) a rising trend.

Fig. 3 shows the distribution of developing countries according to the latest data on prevalences of stunting. Prevalences are categorized as low, medium, high and very high (<20%, 20–29%, 30–39% and $\geqslant$ 40%, respectively) (*1*). The rates of

Table 3. **Numbers of stunted children, by UN regions and subregions, over the period 1980 to 2005**

UN regions and subregions	No. of stunted children (x10^6)					
	1980	1985	1990	1995	2000	2005
Africa	34.8 (31.1–38.5)[a]	38.5 (34.8–42.3)	41.7 (37.7–45.6)	44.5 (40.0–49.0)	47.3 (41.8–52.8)	49.4 (42.5–56.3)
Eastern Africa	12.9 (10.8–15.0)	14.8 (12.8–16.9)	17.1 (14.9–19.3)	19.3 (16.7–21.9)	22.0 (18.7–25.4)	24.4 (20.0–28.8)
Northern Africa	6.0 (4.6–7.4)	6.0 (4.7–7.3)	5.5 (4.3–6.8)	4.9 (3.6–6.2)	4.4 (2.8–6.1)	3.9 (1.9–5.9)
Western Africa	9.0 (7.5–10.6)	10.5 (9.1–12.0)	12.0 (10.5–13.4)	13.5 (11.7–15.2)	14.7 (12.3–17.1)	16.0 (12.7–19.3)
Asia	173.4 (158.2–188.6)	169.7 (153.8–185.6)	167.7 (150.4–184.9)	143.5 (127.0–160.1)	127.8 (110.8–144.8)	110.2 (92.7–127.7)
South-central Asia	89.4 (79.3–99.4)	93.4 (82.3–104.6)	93.4 (81.3–105.4)	83.6 (71.8–95.5)	78.5 (66.1–91.0)	72.3 (59.2–85.4)
South-eastern Asia	27.7 (22.5–32.9)	26.5 (21.2–31.8)	24.2 (18.9–29.6)	21.5 (16.1–26.9)	18.9 (13.3–24.5)	15.8 (10.1–21.5)
Latin America and the Caribbean	13.2 (11.1–15.3)	11.9 (9.8–14.0)	10.4 (8.2–12.6)	8.6 (6.3–10.9)	6.8 (4.3–9.3)	5.1 (2.3–8.0)
Caribbean	0.9 (0.5–1.3)	0.9 (0.5–1.3)	0.8 (0.4–1.2)	0.7 (0.3–1.1)	0.6 (0.2–1.0)	0.5 (0.1–0.9)
Central America	3.9 (2.4–5.4)	3.8 (2.3–5.3)	3.9 (2.2–5.5)	3.9 (2.0–5.9)	3.9 (1.6–6.2)	3.8 (1.1–6.5)
South America	8.4 (6.8–10.0)	7.3 (5.8–8.9)	6.1 (4.4–7.7)	4.6 (2.9–6.2)	3.2 (1.4–4.9)	1.8 (0.0–3.8)
All developing countries	221.3 (200.3–242.4)	220.1 (198.3–241.9)	219.7 (196.4–243.1)	196.6 (173.2–220.0)	181.9 (156.9–207.0)	164.7 (137.5 –191.9)

[a] Figures in parentheses are the 95% confidence intervals.

stunting in many countries of sub-Saharan Africa, South-central Asia and South-eastern Asia remain very high. In Latin America and the Caribbean the majority of countries have low or moderate rates.[c]

Discussion

In developing countries, child malnutrition, as measured by stunting, has fallen progressively from 47% in 1980 to about 33% in 2000. Despite increases in population, the estimated number of stunted children aged under 5 years has decreased by almost 40 million in these countries during the last 20 years. However, the data presented confirm that child malnutrition remains a major public health problem in developing countries, where a third of all children aged under 5 years are stunted; 70% of them live in Asia, mainly South-central Asia, 26% live in Africa and about 4% live in Latin America and the Caribbean. These estimates are consistent with those reported elsewhere (*18*). Progress has been uneven; indeed, in some countries the rates of stunting are rising and in many, especially in sub-Saharan Africa and South-central Asia, they remain very high.

Eastern Africa is the only region to exhibit an increase in the average prevalence of stunting (0.08 percentage points per year). This subregion includes Djibouti, Ethiopia, Madagascar, Rwanda, and Zambia, all of which have experienced a deteriorating trend since 1980 (Table 4). All other subregions show decreases, ranging from 0.06 percentage points to 0.98 percentage points per year. Particularly good progress has been made in South-eastern Asia, South-central Asia, and South America. However, in South America there are increasing rates of overweight among children because of rapid changes in dietary patterns and lifestyles in some countries (*19*, *20*). Northern Africa and the Caribbean show modest progress, whereas Western Africa and Central America show very little improvement. There were insufficient data to assess trends in Middle and Southern Africa, but three of the four countries with multiple data in these subregions exhibit a decline in the prevalence of stunting among children (Table 4).

Improvement in the nutritional status of children has been least in Africa, where 9 of the 31 countries with more than one national survey

[c] Prevalence by sex, age group, area of residence and administrative region for each national survey can be obtained from the authors.

Table 4. **National survey data on trends in stunting (<–2 SD for height-for-age) in children under 5 years of age in developing countries**

Country	Years of surveys	% <– 2 SD height-for-age	Overall trends[a]	Percentage point change per year[b]
Africa				
Eastern Africa				
Comoros	1991–92, 1995	33.0, 33.8	→	+0.20
Djibouti	1989, 1996	22.2, 25.7	↗	+0.50
Ethiopia (rural)	1983, 1992	59.8, 64.2	↗	+0.49
Kenya	1978–79, 1993, 1994, 1998	35.4, 33.3, 33.6, 33.0	→	–0.12
Madagascar	1983–84, 1992, 1993–94, 1995, 1997	33.8, 54.1, 48.6, 49.8, 48.3	↗	+1.04
Malawi	1981, 1992, 1995	56.4, 49.2, 48.3	↘	–0.58
Mauritius	1985, 1995	21.5, 9.7	↘	–1.18
Mozambique	1995, 1997	55.0, 35.9	↘	–9.55
Rwanda	1976, 1992	36.6, 48.7	↗	+0.76
Uganda	1988–89, 1995	44.4, 38.3	↘	–0.87
United Republic of Tanzania	1991–92, 1996	43.2, 43.4	→	+0.04
Zambia	1992, 1996–97	39.8, 42.4	↗	+0.52
Zimbabwe	1988, 1994	29.0, 21.4	↘	–1.27
Middle Africa				
Cameroon	1977–78, 1991, 1998	35.6, 26.0, 29.3	↘	–0.30
Central African Republic	1994–95, 1995	33.6, 28.4	↘	–5.20
Northern Africa				
Algeria	1987, 1992, 1995	12.4, 18.1, 18.3	↗	+0.74
Egypt	1978, 1988, 1990, 1992–93, 1994–95, 1995–96, 1996, 1997–98	37.7, 30.9, 30.0, 26.0, 21.6, 29.8, 25.9, 24.9	↘	–0.64
Morocco	1987, 1992	24.9, 24.2	→	–0.14
Tunisia	1973–75, 1988, 1998	39.5, 17.9, 8.3	↘	–1.30
Southern Africa				
Lesotho	1976, 1992, 1994, 1996	41.4, 33.0, 32.9, 44.0	→	+0.13
South Africa	1993–94, 1994–95	25.4, 22.8	↘	–1.30
Western Africa				
Cape Verde	1983, 1994	15.3, 16.2	→	+0.08
Côte d'Ivoire	1986, 1994	17.2, 24.4	↗	+0.90
Ghana	1987–88, 1988, 1993–94, 1998–99	30.5, 29.4, 25.9, 25.9	↘	–0.38
Mali	1987, 1995–96, 1996	23.8, 30.1, 48.6	↗	+2.76
Mauritania	1988, 1990–91, 1995–96	34.0, 56.9, 44.0	↗	+1.25
Niger	1985, 1992, 1998	37.7, 39.5, 41.1	→	+0.26
Nigeria	1990, 1993	42.7, 37.7	↘	–1.67
Senegal	1986, 1991–92, 1992–93, 1996	23.0, 29.1, 24.7, 22.9	→	–0.01
Sierra Leone	1974–75, 1977–78, 1989, 1990	34.1, 42.8, 35.2, 34.7	→	+0.04
Togo	1976–77, 1988, 1996, 1998	33.7, 33.6, 34.0, 21.7	↘	–0.55
Asia				
South-central Asia				
Bangladesh	1982–83, 1985–86, 1989–90, 1992, 1995–96, 1996–97	67.7, 67.5, 64.6, 64.2, 51.4, 54.6	↘	–0.87
Bhutan	1986–88, 1999	56.1, 40.0	↘	–1.34
India (rural)	1974–79, 1988–90, 1991–92	72.3, 62.1, 61.2	↘	–0.69
Islamic Republic of Iran	1995, 1998	18.9, 15.4	↘	–1.17
Maldives	1994, 1995, 1997–98	29.6, 26.9, 36.0	↗	+1.60
Nepal	1975, 1995, 1996,	69.4, 60.1, 48.4,	↘	–1.00
Pakistan	1977, 1985–87, 1990–91, 1990–94	67.0, 57.9, 49.6, 36.3	↘	–1.92
Sri Lanka	1977–78, 1980–82, 1987, 1993, 1995	44.6, 36.2, 27.2, 23.8, 20.4	↘	–1.34

(Table 4, continued)

Country	Years of surveys	% <– 2 SD height-for-age	Overall trends[a]	Percentage point change per year[b]
South–eastern Asia				
Lao People's Democratic Republic	1993, 1994	48.0, 47.3	↘	–0.70
Myanmar	1980–81, 1983–85, 1991, 1994	48.0, 49.7, 40.0, 44.6	→	–0.24
Philippines	1971–75, 1982, 1987, 1989–90, 1992, 1993	55.3, 42.8, 38.6, 37.2, 34.7, 32.7	↘	–1.13
Thailand	1987, 1993	21.5, 16.0	↘	–0.92
Viet Nam	1983–84, 1987–89, 1992–93, 1994, 1998, 1999	59.7, 56.5, 49.5, 46.9, 35.9, 38.7	↘	–1.31
Western Asia				
Jordan	1990, 1997	15.8, 7.8	↘	–1.14
Kuwait	1983–84, 1994–95,	12.2, 10.7	→	–0.13
Oman	1991, 1994–95	20.7, 15.7	↘	–1.00
Syrian Arab Republic	1993, 1995	26.6, 20.8	↘	–2.90
Turkey	1993, 1998	20.5, 16.0	↘	–0.70
Yemen	1991–92, 1996, 1997	44.1, 44.6, 42.4	→	–0.28
Latin America and the Caribbean				
Caribbean				
Dominican Republic	1986, 1991, 1996	20.6, 16.5, 10.7	↘	–0.99
Haiti	1978, 1990, 1994–95	39.6, 33.9, 31.9	↘	–0.45
Jamaica	1978, 1989, 1991, 1992, 1993	12.1, 8.7, 6.2, 10.6, 9.6	→	–0.17
Trinidad and Tobago	1976, 1987	12.4, 4.8	↘	–0.69
Central America				
Costa Rica	1982, 1996	7.6, 6.1	→	–0.11
El Salvador	1988, 1993	29.9, 23.1	↘	–1.36
Guatemala	1987, 1995	57.7, 49.7	↘	–1.00
Honduras	1987, 1991–92, 1993–94, 1996	37.2, 36.3, 39.6, 38.9	→	+0.19
Mexico (rural)	1974, 1979, 1988, 1989, 1996	42.6, 26.7, 36.4, 35.1, 33.9	↘	–0.40
Nicaragua	1980–82, 1993, 1997–98	21.7, 22.5, 24.9	→	+0.19
Panama	1980, 1992	22.0, 9.9	↘	–1.01
South America				
Bolivia	1981, 1989, 1993–94, 1996, 1998	42.7, 37.7, 26.8, 29.1, 26.8	↘	–0.94
Brazil	1975, 1989, 1996	32.0, 15.4, 10.5	↘	–1.02
Chile	1984, 1985, 1986, 1993, 1994, 1995, 1996	9.9, 9.5, 9.6, 6.6, 2.6, 2.4, 2.3	↘	–0.63
Colombia	1965–66, 1977–80, 1986, 1989, 1995	31.9, 22.4, 25.3, 16.6, 15.0	↘	–0.56
Guyana	1971, 1981	23.7, 20.7	↘	–0.30
Peru	1975, 1984, 1991–92, 1996	39.7, 37.8, 31.8, 25.8	↘	–0.66
Uruguay	1987, 1992–93	15.9, 9.5	↘	–1.07
Venezuela	1981–82, 1987, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997	6.4, 4.6, 13.8, 13.5, 13.6, 12.8, 13.2, 14.1, 14.4, 14.9	↗	+0.53
Oceania				
Melanesia				
Solomon Islands	1970, 1989	25.7, 27.3	→	–0.08

[a] Rising ↗ : ⩾0.30 percentage points per year.

Static → <0.30 or > –0.30 percentage points per year.

Falling ↘ –0.30 percentage points per year.

[b] Percentage point change per year calculated by dividing the difference between the earliest and latest data points by the number of years between the two surveys. Trends are classified as rising, static or falling according to the cut–offs listed above.

Fig. 3. **Prevalence of stunted under-5-year-old children in developing countries**

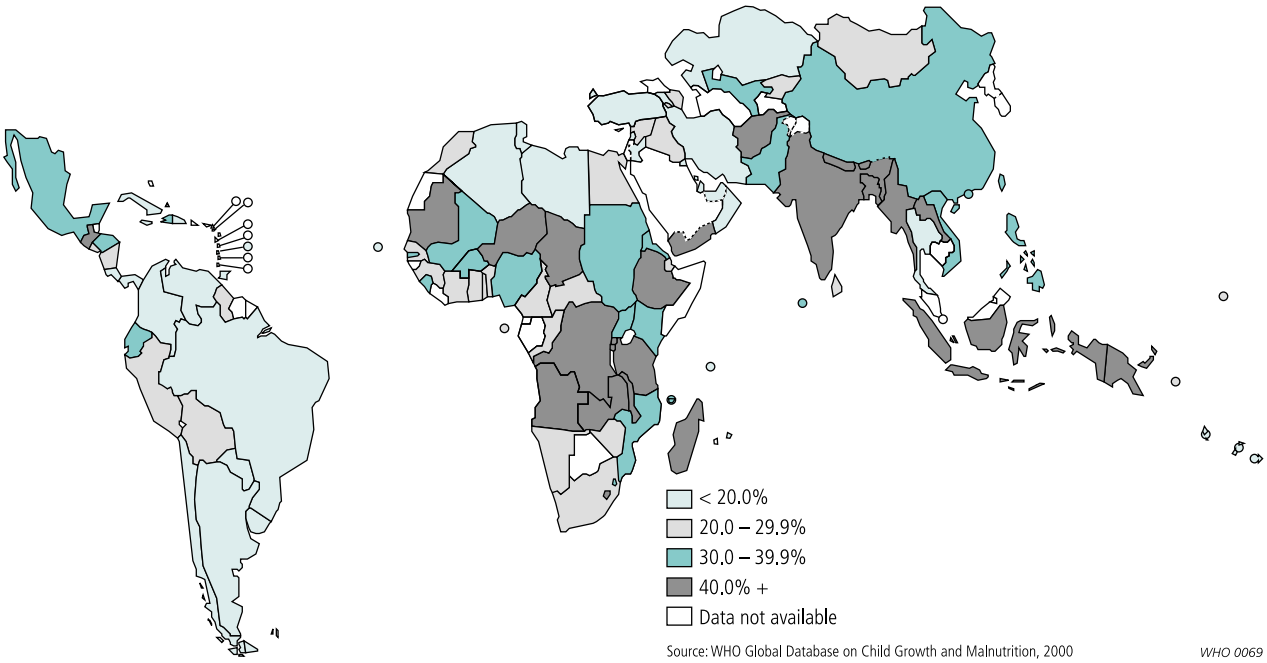


exhibit a rising trend in stunting rates and 9 other countries show no change (Table 4). The number of stunted children in this region has increased by more than one-third between 1980 and 2000. The best progress in the region has occurred in Northern Africa; indeed, increasing rates of overweight among children are occurring (*20*). Egypt, with the largest child population in the subregion, strongly influences the overall pattern of improvement for this group of countries. Table 4 shows the steady decrease in the prevalence of stunting that Egypt has experienced since the late 1970s. Stunting remains very widespread in South-central Asia, despite substantial progress made since 1980. This subregion includes Afghanistan, Bangladesh, Bhutan, India, Nepal, and Pakistan, all of which have very high levels of child malnutrition (Table 4).

What explains the differences between countries in reducing child malnutrition? The causes of child malnutrition are complex and multidimensional, ranging from factors as fundamental as political instability and slow economic growth to highly specific ones such as infectious diseases. Furthermore, important determinants of child malnutrition, e.g. the prevalence of intrauterine growth retardation, vary considerably across geographical regions (*21*). Stunting is a cumulative process that starts in utero, and there is substantial evidence that intrauterine growth is a strong predictor of postnatal growth (*1*).

There is considerable variability in stunting among preschool children between countries and between provinces within countries. Whether children are undernourished is as much a consequence of factors at the national and provincial levels as of circumstances at the level of the individual or household. National factors and geographical locations explain 76% of national variability in stunting. The most important factors associated with lower prevalence of stunting are the availability of high energy, female literacy and gross national product. However, the association of health expenditures and stunting differs between regions (*22*).

Women's educational and social status, national per capita food availability, and access to safe water are important underlying determinants of child nutritional status (*23*). Furthermore, a review of the situation in Asia has suggested that high prevalence of low birth weight, poor hygiene, inadequate child care and feeding practices, and the low status of women in society are key factors that explain high rates of child malnutrition (*24*).

Among the constraints on the present study are a lack of sufficient trend data for some subregions and limitations inherent in statistical modelling. Uncertainty in trends was quantified using 95% confidence intervals. Only two regions had large confidence intervals: the Caribbean, where only 4 of the 13 countries had two or more data points on which to base estimates, and Central America, where there was wide variability in trends between the countries contributing data. The multilevel modelling method used in the present study is the same as that employed in the *Third and Fourth reports on the world nutrition situation* (*25, 26*). The *Fourth report* included a comparison of statistical methods for estimating trends in child malnutrition and concluded that this multilevel model was the method of choice (*26*). As more data become available, an extended model with random country trends will become feasible. Despite the constraints, we consider that the present study is a valid attempt to describe trends in child malnutrition and that it can serve as a baseline for assessing progress. The present estimates can also help in the

identification of countries and regions in need of interventions in entire populations to prevent and control child malnutrition.

Efforts to reduce child malnutrition should be based on experience gained from successful nutrition programmes. The Tamil Nadu Integrated Nutrition Programme has had a substantial impact through a combination of targeted interventions in the fields of health, food and education (*27*). Community-based programmes in Thailand, the United Republic of Tanzania, and Zimbabwe have contributed significantly towards reducing child malnutrition rates (*27*, *28*), and similar results have recently been obtained in Madagascar and Senegal (*29*). Such programmes should be undertaken more widely. A distinguishing feature of successful programmes has been the involvement of communities in the identification of problems and in the measures taken to resolve them. Future interventions should follow these examples and focus on children aged up to 3 years, when growth faltering mainly occurs (*1*). Special efforts should be made to improve the situation of women as primary child carers, with particular reference to their health and nutrition throughout the life cycle. Moreover, it is essential to give careful attention to complementary feeding and to the protection and promotion of breastfeeding.

The analysis assumed that past trends will continue. However, it remains to be seen whether regions that have made good progress in reducing malnutrition can continue to do so. The most rapid progress in reducing the prevalence of child malnutrition has occurred in Asia, partly because of economic growth. Unfortunately, the recent economic crisis has to some extent shaken confidence in the prospects for continuing improvement. Progress in most other regions has been more modest than would have been expected. In Eastern Africa the natural disasters that have recently affected Madagascar, Mozambique, and Zimbabwe are likely to contribute to the deteriorating trends in child malnutrition predicted for 2005.

Conclusion

Most developing countries have experienced important decreases in child mortality rates over the last three decades. As greater numbers of children survive, it becomes critical to pay closer attention to the strong relationship between nutritional status and children's ability to achieve optimal physical growth and psychological development. Impaired growth and development in children can affect the rest of their lives and compromise academic performance and the ability to contribute to society (*30*). Investment in interventions aimed at improving physical growth and mental development in children can be expected not only to decrease the prevalence of stunting but also to prevent its negative functional consequences throughout the life cycle. There is a great need to focus the attention of policy-makers on the nutritional status of children as one of the main indicators of development and as a precondition for the socioeconomic advancement of societies in the long term. ■

Résumé

La malnutrition est-elle en régression ? Une analyse de l'évolution des taux de malnutrition infantile depuis 1980

Les enfants qui souffrent d'un retard de croissance par suite d'un mauvais régime alimentaire et/ou d'infections récurrentes sont davantage exposés à plusieurs maladies infectieuses et à un risque accru de décès. Une croissance insuffisante est également associée à un retard du développement mental et à des troubles fonctionnels importants chez l'adulte. De nombreuses enquêtes ont été menées dans ce domaine depuis les années 70, mais un manque de comparabilité a rendu difficile le suivi des tendances de la malnutrition infantile. Des données transversales provenant d'enquêtes représentatives à l'échelle nationale ont été analysées de manière uniforme pour obtenir des résultats comparables concernant le faible rapport poids/âge. La modélisation à plusieurs niveaux a été utilisée pour estimer les tendances régionales et mondiales de 1980 à 2005. Les pays ont été groupés selon la classification des Nations Unies. On a obtenu des données de 241 enquêtes représentatives à l'échelle nationale menées dans 106 pays en développement, dont 65 disposaient de données provenant de plusieurs enquêtes. En 2000, on estime que 32,5 % des enfants de moins de cinq ans des pays en développement auront un retard de croissance. On a constaté à cet égard une amélioration régulière depuis 1980, date à laquelle la prévalence mondiale estimative du retard de croissance avoisinait les 50 %. On prévoit que cette proportion aura été ramenée à environ 29 % en 2005. Une diminution régulière a été enregistrée en Asie et en Amérique latine et dans les Caraïbes, bien que leurs taux de retard de croissance soient très différents. La prévalence du retard de croissance en Asie est passée de 52,2 % en 1980 à 34,4 % en 2000, tandis qu'en Amérique latine et dans les Caraïbes, elle est tombée de 25,6 à 12,6 % pendant la même période. En Afrique, la prévalence du retard de croissance est passée de 40,5 % en 1980 à 35,2 % en 2000. C'est en Afrique orientale qu'on relève le taux le plus élevé de retard de croissance : en moyenne, 48 % des enfants d'âge préscolaire y sont touchés et le retard de croissance augmente de 0,08 point de pourcentage par an. En 2000, on estime que quelque 182 millions d'enfants d'âge préscolaire des pays en développement ont un retard de croissance, soit 40 millions de moins qu'en 1980. De ces enfants, 70 % vivent en Asie, principalement en Asie du Sud centrale ; environ 26 % vivent en Afrique et environ 4 % seulement en Amérique

latine et dans les Caraïbes. Les données actuelles confirment que la malnutrition infantile reste un problème majeur de santé publique dans les pays en développement. Bien que les taux globaux de retard de croissance aient baissé régulièrement au cours des 20 dernières années, les progrès ont été inégaux. Dans certains pays, les taux de retard de croissance augmentent et dans beaucoup d'autres, particulièrement en Afrique subsaharienne et en Asie du Sud centrale, ils demeurent très élevés. Les interventions visant des populations entières et fondées sur l'expérience acquise au cours de l'exécution de programmes de nutrition efficaces doivent être axées sur les trois premières années de la vie, car c'est surtout pendant cette période que se produit la cassure de la courbe de croissance. Il est indispensable de polariser l'attention des décideurs sur l'état nutritionnel des enfants, car c'est l'un des principaux indicateurs du développement et une condition préalable du progrès socio-économique durable des sociétés.

Resumen

¿Está disminuyendo la malnutrición? Análisis de la evolución del nivel de malnutrición infantil desde 1980

Los niños que sufren retraso del crecimiento como consecuencia de una alimentación deficiente y/o de infecciones recurrentes son más vulnerables a varias enfermedades infecciosas y sufren un mayor riesgo de defunción. El crecimiento escaso también se asocia a un retraso del desarrollo mental y a deficiencias funcionales importantes en la vida adulta. Se han realizado muchas encuestas en este campo desde los años setenta, pero la imposibilidad de compararlas ha dificultado la vigilancia de la evolución de la malnutrición infantil. Se procedió a analizar de forma normalizada datos transversales de encuestas representativas de países a fin de obtener resultados comparables en lo que respecta a la estatura baja para la edad. Se efectuó una modelización multinivel para estimar las tendencias regionales y mundiales entre 1980 y 2005. Los países se agruparon conforme al sistema de clasificación de las Naciones Unidas. Se obtuvieron datos de 241 encuestas representativas del ámbito nacional de 106 países en desarrollo, a 65 de los cuales les correspondieron datos de más de una encuesta. En 2000, se calcula que un 32,5% de los menores de cinco años de los países en desarrollo sufren retraso de su desarrollo físico. Las mejoras en este sentido han sido constantes desde 1980, cuando la prevalencia mundial estimada de retraso del crecimiento era casi del 50%. Se prevé que esa proporción habrá descendido aproximadamente a un 29% para 2005. Se ha producido una disminución constante en Asia y en América Latina y el Caribe, si bien sus niveles de retraso del crecimiento eran muy diferentes. La prevalencia de retraso del crecimiento en Asia ha disminuido de un 52,2% en 1980 a un 34,4% en 2000, mientras que en América Latina y el Caribe se ha reducido del 25,6% al 12,6% durante el mismo periodo. En África la prevalencia ha descendido de un 40,5% en 1980 a un 35,2% en 2000. El mayor nivel de retraso del crecimiento corresponde al África oriental, donde como promedio un 48% de los niños en edad preescolar están afectados y el retraso del crecimiento ha aumentado a razón de 0,08 puntos porcentuales al año. Se estima que en 2000 aproximadamente 182 millones de niños en edad preescolar de los países en desarrollo sufrirán retraso del crecimiento, lo que representa 40 millones menos que en 1980. De esos niños, el 70% viven en Asia, principalmente en el Asia meridional central; en torno a un 26% viven en África; y sólo un 4% aproximadamente viven en América Latina y el Caribe. Estos datos confirman que la malnutrición infantil sigue constituyendo un serio problema de salud pública en los países en desarrollo. Aunque se considera que las tasas globales de retraso del crecimiento han caído de forma sostenida durante los 20 últimos años, el progreso ha sido desigual. En algunos países esas tasas están aumentando, y en muchos de ellos, especialmente en el África subsahariana y en Asia meridional central, siguen siendo muy altas. Las intervenciones dirigidas a toda la población y basadas en la experiencia adquirida en programas nutricionales exitosos deben centrarse en los tres primeros años de vida, periodo en el que más se manifiestan los retrasos del crecimiento. Es indispensable señalar a la atención de los formuladores de políticas que el estado nutricional de los niños es uno de los indicadores principales del desarrollo y un requisito para el progreso socioeconómico de las sociedades a largo plazo.

References

1. *Physical status: the use and interpretation of anthropometry.* Geneva, World Health Organization, 1995 (WHO Technical Report Series, No. 854).
2. **Tomkins A, Watson F.** *Malnutrition and infection: a review.* Geneva, United Nations Administrative Committee on Coordination/Subcommittee on Nutrition, 1989 (ACC/SCN State-of-the-art Series, Nutrition Policy Discussion Paper No. 5).
3. **Man WDC et al.** Nutritional status of children admitted to hospital with different diseases and its relationship to outcome in the Gambia, West Africa. *Tropical Medicine and International Health*, 1998, **3**: 1–9.
4. **Victora CG et al.** Risk factors for pneumonia in a Brazilian metropolitan area. *Pediatrics*, 1994, **93** (6, Part 1): 977–985.
5. **Pelletier D, Frongillo EA, Habicht JP.** Epidemiologic evidence for a potentiating effect of malnutrition on child mortality. *American Journal of Public Health*, 1993, **83**: 1130–1133.
6. **Schroeder DG, Brown KH.** Nutritional status as a predictor of child survival: summarizing the association and quantifying its global impact. *Bulletin of the World Health Organization*, 1994, **72**: 569–579.
7. **Pelletier DL et al.** The effects of malnutrition on child mortality in developing countries. *Bulletin of the World Health Organization*, 1995, **73**: 443–448.

8. **Pollitt E et al.** Early supplementary feeding and cognition. *Monographs of the Society for Research in Child Development*, 1993, **58**: 1–99.
9. **Mendez MA, Adair LS.** Severity and timing of stunting in the first two years of life affect performance on cognitive tests in late childhood. *Journal of Nutrition*, 1999, **129**: 1555–1562.
10. **Martorell R et al.** Long-term consequences of growth retardation during early childhood. In: Hernandez M, Argente J, eds. *Human growth: basic and clinical aspects*. Amsterdam, Elsevier Science Publishers, 1992: 143–149.
11. *Nutrition, health and child development*. Washington, DC, Pan American Health Organization, 1998 (PAHO Scientific Publication No. 566).
12. **Spurr GB, Barac-Nieto M, Maksud MG.** Productivity and maximal oxygen consumption in sugar cane cutters. *American Journal of Clinical Nutrition*, 1977, **30**: 316–321.
13. **de Onis M et al.** The worldwide magnitude of protein-energy malnutrition: an overview from the WHO Global Database on Child Growth. *Bulletin of the World Health Organization*, 1993, **71**: 703–712.
14. **de Onis M, Blössner M.** *WHO global database on child growth and malnutrition*. Geneva, World Health Organization, 1997 (unpublished document WHO/NUT/97.4).
15. **Bryk AS, Raudenbush SW.** *Hierarchical linear models: applications and data analysis methods*. Newbury Park, CA, Sage Inc., 1992.
16. *SAS/STAT software: changes and enhancements through release 6.12*. Cary, NC, SAS Institute Inc., 1997.
17. *World population prospects. The 1996 revision*. New York, United Nations, 1998.
18. *State of the world's children*. New York, United Nation Children's Fund, 2000.
19. **Martorell R et al.** Obesity in Latin American women and children. *Journal of Nutrition*, 1998, **128**: 1464–1473.
20. **de Onis M, Blössner M.** Overweight prevalence and trends among preschool children in developing countries. *American Journal of Clinical Nutrition* (in press).
21. **de Onis M, Blössner M, Villar J.** Levels and patterns of intrauterine growth retardation in developing countries. *European Journal of Clinical Nutrition*, 1998, **52** (S1): S5–S15.
22. **Frongillo EA, de Onis M, Hanson KMP.** Socioeconomic and demographic factors are associated with worldwide patterns of stunting and wasting of children. *Journal of Nutrition*, 1997, **127**: 2302–2309.
23. **Smith LC, Haddad L.** *Explaining child malnutrition in developing countries: a cross-country analysis*. Washington, DC, International Food Policy Research Institute, 1999 (Food Consumption and Nutrition Division, Discussion Paper No. 60).
24. **Ramalingaswami V, Jonsson U, Rohde J.** *The Asian enigma. The progress of nations*. New York, United Nations Children's Fund, 1996.
25. *Third report on the world nutrition situation*. Geneva, United Nations Administrative Committee on Coordination/ Sub-Committee on Nutrition, 1997.
26. *Fourth report on the world nutrition situation*. Geneva, United Nations Administrative Committee on Coordination/ Sub-Committee on Nutrition, 2000.
27. **Jennings J et al.** *Managing successful nutrition programmes*. Geneva, United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition, 1991 (ACC/SCN State-of-the-art Series, Nutrition Policy Discussion Paper No. 8).
28. **Gillespie S, Mason J, Martorell R.** *How nutrition improves*. Geneva, United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition, 1996 (ACC/SCN State-of-the-art Series, Nutrition Policy Discussion Paper No. 15).
29. **Marek T et al.** Successful contracting of prevention services: fighting malnutrition in Senegal and Madagascar. *Health Policy and Planning*, 1999, **14**: 382–389.
30. *A critical link. Interventions for physical growth and psychological development*. Geneva, World Health Organization, 1999 (unpublished document WHO/CHS/CAH/99.3).